



**Fermilab**

RADIATION PHYSICS NOTE NO. 21

N5 Beam Line Radiation Measurement

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One of the constraints imposed on possible radiation levels in outdoor areas is that under accident conditions the dose rate must not exceed 100 mrem/pulse.<sup>1</sup> To determine the maximum allowable flux which could be transported in the N5 line to Lab E, several radiation surveys were performed using an integrating ionization chamber. These measurements were performed at low intensity ( $\sim 10K$  particles per pulse at the loss point) normalized to the scintillation counter upstream of the loss point. The results are presented in Table I.

These measurements were made at the maximum dose rate found radially from the loss point. The radial thickness of the target is in all cases thin, ranging from 3/8" to 10" and therefore as a first approximation one would not expect the dose rate per proton to change with incident energy. This is apparently illustrated by the measurements on the roof of Enclosure 106.

The measurements made at the beam pipe are within inches of the loss point where there are large gradients in the radiation field. The discrepancy in the measurements may be due to the beam drifting and therefore the loss point moving with respect to the detector.

The 350 GeV/c data will be used to illustrate the implications of the above measurements. If  $1 \times 10^{13}$  ppp were

accidentally targetting in Enclosure 100, then to prevent 100 mrem/pulse at the beam pipe, the beam optics upstream would have to limit the transmission by a factor of:

$$\frac{6.7 \times 10^6}{1 \times 10^{13}} = 6.7 \times 10^{-7}$$

If the beam pipe loss problem were corrected then the next limiting case<sup>2</sup> would be the wall of E106,

$$\frac{3.2 \times 10^8}{1 \times 10^{13}} = 3.2 \times 10^{-5}$$

Then if one were normally targetting  $2 \times 10^{10}$  in Enclosure 100 and the limiting case was the wall of E106, then,  $2 \times 10^{10}$  ppp  $\times 3.2 \times 10^{-5} = 6.4 \times 10^5$  ppp transmitted downstream of Enclosure 101 would stay within 100 mrem/pulse under accident conditions.

The above illustration will scale linearly with intensity, therefore, if one were targetting  $1 \times 10^{11}$  ppp in E100, then  $1 \times 10^{11}$  ppp  $\times 3.2 \times 10^{-5} = 3.2 \times 10^6$  ppp could be transmitted downstream of Enclosure 101.

The Neutrino Department is presently working on solutions to the above problems.

#### REFERENCES

1. Radiation Physics, Radiation Guide, (1978 Edition)  
Chapter 6.1.5
2. The roof of Enclosure 103 above the upstream collimator may be more limiting than the wall of Enclosure 106. To determine this, a scintillation counter upstream of the collimator is required.

TABLE I

Number of Protons Resulting in 100 mrem

LOCATION BEAM DUMPED - MEASURED	DIFFRACTED PROTONS		NORMALIZED TO
	150 GeV/c	350 GeV/c	
E106 Collimator - E106 Roof	$9.5 \times 10^8$	$9.5 \times 10^8$	Scintillation Paddle U.S. E106
E106 Collimator - E106 West Wall	$3.2 \times 10^8$		Scintillation Paddle U.S. E106
Magnet SW05 - East Wall E105		$12 \times 10^8$	Scintillation Paddle U.S. E105
Beam Pipe Between E105 - E106	$2.5 \times 10^7$	$6.7 \times 10^6$	Scintillation Paddle D.S. E105